A COMPARISON OF LEARNING BETWEEN MENTAL DEFECTIVES, MENTAL RETARDATES AND NORMALS

By

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CHAPTER 1

BACKGROUND AND PROBLEM

The present study represents a convergence of two lines of interest: one, a comparison of the performances of intellectually subnormal and intellectually average children in a non-test problem solving situation, and two: a comparison of learning processes between different clinical groups of mentally subnormal children.

Some of the available literature seems to indicate that the ability to solve problems may be better in a non-test situation than in a test situation. There has also been evidence that the adult level of non-test problem solving performances of many individuals who, when children, received test scores indicating retardation, is better than might have been predicted from their test scores. Baller (1936) studied 206 subjects who, as children, were diagnosed as mentally retarded and all with IQ's below 70. They were individually matched with 206 controls in relation to sex, nationality, and age. The controls all obtained IQ scores between 100 and 120. The subjects all had an average age of 27 years at the time of the study and had been out of school approximately 9 years. Baller (1936) found that 83% of the mental retardates were self-supporting. While many of them tended to move frequently from neighborhood to neighborhood more than the controls, they moved within a restricted range. Fewer mental defectives were married but when only those defectives outside of the institution were considered, the ratio for both groups was the same. Sixty-one percent of the mental defectives could not hold steady employment, but, importantly, 39% did. Baller noted also that even with institution children, social age equals mental age (as measured by the Vineland Social Maturity Scale) until the chronological age of 15 was almost reached; then social age is usually about a year higher than mental age.

Muench (1944) made a follow-up study of mental defectives after 18 years. Though his study is limited by the number of mental defectives that he was able to locate, it is here cited as of some interest. He felt that social competency was significantly correlated with the degree of freedom from supervision by others. The tests utilized in the follow-up were the Vineland, Stanford Achievement, Intermediate Reading, and Porteus Maze. The subjects were 40 boys from a school in Columbus, Ohio who were diagnosed as mentally defective in 1925 on the basis of standardized intelligence tests. They were all considered to be educationally retarded and of inferior mental ability. Muench was able to track down only eight subjects, and of this group, 4 were definitely mentally deficient and 4 were borderline. The results of this study indicated a trend in the direction of a positive change toward improvement in most tests, reflecting positive changes in mental age, IQ, and social competency. This trend was found on intelligence tests and not on reading tests; so the improvement on intelligence test scores could not be attributed to an improvement in reading ability. These individuals were all making a good social adjustment in the same city in which they were originally institutionalized. All but one of the group were married with a range of from 1 to 14 years and a mean of 9 years. Generally they lived in inferior neighborhoods but three were in good neighborhoods and the subject with the poorest original prognosis owned his own home. Salaries earned ranged from $38-$55 a week and the number of years employed with the same companies ranged from 1-14 years and each family had insurance. None had a court record for a serious crime since attaining adult status.

A study compiled by Ginzberg and Bray (1953) gives evidence that a large group of adults, who, while they were not diagnosed as defective when children, were diagnosed as either educationally retarded or as mentally defective as adults on the basis of test scores, yet were able to learn at a rate beyond that predicted by their test scores. Ginzberg and Bray (1953) reported that during World War II about 400,000 illiterates and 300,000 poorly educated soldiers served with the army after approximately 700,000 were rejected on the basis of mental deficiency. An army special training unit was set up for training those men who were formally classified as illiterate and those who scored low on the Army General Classification Test. The purpose of the training was to teach these men to be able to read at the 4th grade level, to obtain sufficient ability in language skills to enable them to understand day to day oral and written speech, and to be able to do 4th grade arithmetic. The maximum time each man could remain in the special course was 120 days. About 40% graduated in less than 30 days, 80% graduated in less than 60 days, and only 11,000 men remained for more than 90 days. A total of 255,000 were graduated from the course. Certainly several criticisms of the results are valid. There is no doubt that some of these men were not actually retarded but were only illiterate. The often brief and hasty diagnostic procedures utilized by the Army to screen applicants may have resulted in a number of errors. Probably a number of men did not even complete the course. However, one aspect in this study is that, as mentioned above, the rate of learning was greater than could have been indicated by the test scores obtained from these men.

There are two points apparent from the above evidence. One is that individuals who have been diagnosed as mentally defective when children on the basis of test scores have indicated that they can learn a greater rate than their test scores could have suggested. Making a satisfactory social and economic adjustment in the community requires the ability to solve problems on a rather complex level. Apparently these individuals were able to solve problems in many situations other than those met in intelligence test situations.

The second point suggested is the clear inadequacy of many conclusions relating to mental retardation which have been based on data obtained solely from intelligence test scores. The statement was made above that such tests may measure a narrowly limited range of problem solving situations. The studies of Davis and Havighurst (1948) indicate that intelligence tests sample only a limited number of intellectual processes and, of those processes sampled, most are those which would be necessary for school performance. Also, the work of Davis and Havighurst (1948) indicates that conventional intelligence tests consist of items related to a middle class culture only and are generally validated on a middle class sample. The significance of these studies is magnified by the fact that a large percent of the mentally retarded are of lower social class status.

In attempting to devise a test that is not limited by culturally influenced items, Davis and Eels (1953) state, "a general intelligence test is valid if it measures over-all capacity to solve mental problems." Since scientists have discovered no objective criteria of intelligence, previous test constructors have tended to rely on the correlation of test scores with school grades and upon the fact that their problems proved more difficult for lower age groups than for higher age groups as evidence that their tests were actually valid measures of intelligence. But, as many have pointed out, school grades are greatly influenced by work habits, attention, conscientiousness, home training, desire to compete, etc. There is little evidence that the type of problem solving behavior required in conventional intelligence tests is significantly correlated with the problem-solving behavior required in a non-test situation. There may be a number of factors which are very important in non-test problem solving behavior but they may not be included in present conventional tests; hence these factors are not being measured.

The next logical step is to hypothesize that our present concepts of intelligence may not be sufficient. Actually, not much is really known about many psychological processes, and their interactions, nor do we really know how such factors as education, training, motivation, etc. are reflected in the psychological processes. New concepts have recently been suggested. Guilford (1956) has described 3 groups of factors which fall under the general heading of thinking: cognition, production, and evaluation. Cognition factors are related to the awareness of mental constructs. Something must be recognized or discovered by the subject. After the situation has been comprehended, something must be done to it or about it. Some end result is produced. Finally, evaluation factors are related to conclusions about the appropriateness or effectiveness of the produced result. In short, a situation is recognized, something is done about it, and the question is raised: is the product or solution correct or workable? Guilford (1956) felt that productions and evaluation have not been previously studied or considered as intellectual processes. Sarason and Gladwin (1958) feel that these two groups of factors have not been included in conventional tests and may account for the differences between test and non-test performance with non-test performance often superior to test performance. Although Guilford's (1956) research has been based on studies of superior adults, it might be speculated that such factors will be functioning in the psychological processes of those in the lower end of the intelligence scales.

The problem of diagnosing and classifying mental sub-normality is a vast and complex one, involving many individual and social factors. However, similarly to "learning", mental sub-normality can only be defined in terms of inferences derived from performance. In short, it can only be described in relation to its results. According to Sarason and Gladwin (1958), the usually accepted criteria for mental retardation have been:

1. The mentally retarded individual is one whose defect existed at birth or shortly after.
2. Mental retardation is manifested in intellectual and social

differences which prevent an individual from solving problems to the extent that others of his age are able to.

3. The mentally retarded individual does now, and probably always will require assistance and guidance from others.
4. Mental retardation is primarily incurable.

Thus the diagnosis of intellectual subnormality is made only in relation to some external criterion of mental normality. Criterion number two relating to the differences which prevent a mentally retarded individual from solving problems as well as others of his age has been considerably utilized in the diagnosis of mental retardation. Although the total personality of an individual including intellectual, emotional, and social factors should be evaluated, unfortunately, measurement of mental ability has usually been the sole criterion. Furthermore, the readily available standardized intelligence tests have primarily been selected as the means of such intellectual evaluations. Although it is certain that these tests correlate significantly with scholastic opportunity and achievement, it may also be possible that such tests may measure only a very narrow range of problem solving situations.

In addition to determining the mentally retarded or mentally defective as a group differing from the mentally normal, distinctions must be made within the classification of mental subnormality. Sarason and Gladwin (1958) make a distinction between the terms "mental deficiency" and "mental retardation." The term "mental retardation" presumes that no organic pathology can be detected and that there are indications of environmental deficit as a basis for below normal mental ability.

In short, the obvious presence or absence of organic pathology will be the distinction between the terms "defective" and "retarded". Neither defectives nor retardates is considered homogeneous as far as etiology of retardation is concerned.

In the above mentioned studies by Muench (1944) and Baller (1936) which indicated that many individuals, diagnosed as defective when children, had made satisfactory adjustments, there was no indication that such a criterion had been utilized, but the implication was that these individuals would have been included in Sarason and Gladwin's (1958) mentally retarded group. At least, in both studies as presented, there is no indication of the presence of any obvious organic defects. Muench's (1944) group were considered retarded as children. Apparently something closely paralleling Guilford's (1956) evaluation factor was available to them: something that was not measurable by the use of standardized intelligence tests but something that they were able to use in order to make an adequate adjustment outside of the institution. Whether their ability to function so satisfactorily in the non-test problem solving situations encountered in everyday living was available to them when they were children is not known. Muench (1944) did find that there was no evidence that IQ's increase after institutionalization but, again, the tool employed as a means of measurement was the standardized intelligence test.

It can be assumed from the above evidence that retarded individuals may perform differently (and often better) in a non-test problem solving situation than they do in a test situation such as the conventional intelligence test. One of the purposes of this study is to compare the performances of intellectually subnormal children with intellectually average children in a non-test problem solving situation.

Within an institution for defective children, it can be observed clinically that many children who obtain similar IQ scores on intelligence tests show qualitative differences in performance. This is especially noticeable when comparing brain damaged children and those classified as "familial" or, in Sarason and Gladwin's (1958) classification, "mentally retarded." Very often the retarded child performs much like a normal child, but at the level of a much younger child. On the other hand, the performance of the brain damaged child is often more variable, providing glimpses of good ability with poor ability. Eisenson (1954) describes a number of disturbances of intellect and personality which are considered to be characteristic of the brain damaged child and which are often reflected in behavior. Such disturbances are:

1. Disturbances of attention. The brain damaged individual must expend more effort to attend. Fleeting and non-relevant stimuli often interfere with relevant stimuli.
2. Disturbances of memory: Immediate memory for the brain damaged individual may be deficient as a result of the poor ability to attend.
3. Perseveration: Perseveration is defined by Eisenson as "the tendency for an act or an idea to persist in various situations, often occurring when a brain damaged individual has to expend great effort to obtain a response." For example,

it occurs when the individual is faced with new situations and it may occur when there is difficulty in grasping new situations.

4. Rigidity: Rigidity is defined as a tendency to persist in a "set" or attitude of behavior when such a set is no longer appropriate. For example, this may also occur when the brain damaged individual is faced with a new situation. He is often unable to shift from the attitudes or appropriate behavior of the previous situation.
5. Concretism: This characteristic is described as a tendency to approach each situation as a unique one so that the individual is situation bound and has difficulty in comprehending similarities in situations.

It seems plausible to assume that if adults who were considered to be retarded as children can perform adequately and similarly to intellectually normal adults in everyday adjustments in a community, then retarded children may also perform similarly to intellectually normal children in a non-test problem solving situation, although the intelligence test scores of the retarded may be much lower than those of the normal children. In addition, the assumption might be made that brain damaged children would not perform as adequately as the retarded children or the intellectually normal children because of the various disturbances of intelligent intellect and personality often accompanying an organic disorder. If these assumptions are true, the inadequacies of many predictions and conclusions formulated on the basis of intelligence tests are perhaps more obvious. More specifically, the inadequacy of a test score alone as the basis of commitment to an institution or as a basis for removal from the community is even more glaring.

The purposes of this study are as follows: one, to test the above assumptions that children judged to be retarded on the basis of intelligence test scores may perform more adequately in a non-test problem solving situation, and two, that retarded children will perform more like normal children in a non-test problem solving situation, but brain damaged children will perform inadequately in such a situation.

The first step was the selection of an appropriate non-test problem solving situation which would enable the individual to utilize an ability to evaluate his responses as well as to produce responses, and would enable him to transfer learned principles from one situation to other similar situations.

Considerable work has been done by Harlow (1950) and others in the study of learning sets. Learning set is often referred to as "learning how to learn." More complexly, it can be described as the development of a higher order habit from a single component located in each of a series of problems and consistently reinforced from problem to problem. The reinforced component is the response of choosing one stimulus and then changing this choice if it proves to be incorrect, or continuing the original choice of stimulus if it is found to be correct. In discrimination learning sets, there is a gradual improvement in the ability of a subject to solve successive discrimination problems.

Since the development of the concept of learning set, there have been a number of theoretical conceptualizations of the phenomenon. In a key study, Riopelle (1953) formulated the interpretation of suppression of transfer tendencies. As learning progresses, there is an increasing suppression of negative transfer tendencies from problem to problem. In other words, a new habit (a habit of testing stimulus objects in regard to only one dimension) arises. Thus performance becomes increasingly independent of any particular problem encountered by the subject. Since the acquisition of a learning set involves the development of a higher order, abstract concept from a series of individual problems each containing a component of the concept, learning set problems would seem to be appropriate for studying cognitive processes. In addition, there were several other reasons why discrimination learning was selected as an appropriate non-test problem solving situation:

1. The implication has been made that such concepts as Guilford's production and evaluation factors have been omitted from conventional tests. A learning set problem solving situation in which the subject is aware of the correctness and incorrectness of his responses and can change responses on the next trial would provide an opportunity for the individual to evaluate the appropriateness or suitability of his responses.
2. Discrimination learning would provide a learning situation in which all subjects are relatively equally naive initially. The situation is new and unfamiliar to all subjects regardless of their past education and experience, but in providing a series of problems, it gives an indication of the rate with which learning occurs.

3. Also, by providing a series of problems, discrimination learning gives some indications of the effects of retroactive and proactive interference by indicating the effects of interpolated problems on previously learned responses, and the effects of previously acquired responses on new learning stimuli.

In other words, a series of visual discrimination problems will provide a non-test problem solving situation involving a number of more complex cognitive factors than would be found in a single concrete problem or in a series of unrelated problems.

The hypotheses to be tested are:

1. Mentally retarded children will perform similarly to intellectually average children in a non-test problem solving situation which gives the children an opportunity to evaluate the appropriateness of their responses to given stimuli.

1a. Mentally defective (brain damaged) and mentally retarded (non-brain damaged) children with the same intellectual ability as measured by standardized intelligence tests will perform differently in a non-test problem solving situation. It is predicted that the brain damaged children, because of the characteristic disturbances of memory, attention span, distractibility, perseveration, etc. typical of such children, will acquire a learning set at a much slower rate than retarded or non-brain damaged children.

2. The suppressive effects of previously learned responses on new material is referred to as proactive interference. It

is predicted that the effects of such proactive interference will be greater for the mentally defective children than for the mentally retarded and average children because of the difficulty for the defective children in shifting set from originally learned responses to new material.

2a. It is predicted that there will be no significant difference between the retarded and average groups in relation to the effects of proactive interference.

3. With the introduction of interpolated material, a suppression of previously learned material is referred to as retroactive interference. It is predicted that there will be a greater suppression of performance efficiency for the defective group than for the other two groups with one interpolated problem because of a difficulty in shifting from one set to another for this group. It is predicted that the defective children will manifest less interference in performance after four interpolated problems because they would be more likely to have forgotten which blocks had originally been reinforced.

3a. It is predicted that there will be no significant difference between the retarded and average groups in relation to the effects of retroactive interference.

CHAPTER 2

SUBJECTS, APPARATUS, AND PROCEDURE

Fifty-nine subjects were used in the study. Forty-one of the subjects were institutionalized children in a state home for mental defectives. These children were assigned to two groups on the basis of Sarason and Gladwin's suggested criteria. Group Number 1 consisted of children with central nervous system disorders. These defects were not necessarily present at or before birth. Some undoubtedly were present before birth but this could not be determined with any degree of certainty. Birth injury could be determined as the etiology of the defect in 7 cases, while in 16 cases, injury had occurred shortly after birth or in the early years of childhood. None of these children were manifesting hormonal or metabolic disorders. Sarason and Gladwin state that the criteria for mental retardation assume no central nervous system defect but that the etiology is found in environmental defects. Examination of the records and histories of the institutionalized children classified as mentally retarded did not always indicate any environmental lack. In some cases, there seemed to be no apparent reason for the presence of retardation. Some of these children were not from sub-cultural backgrounds and had not been deprived of an opportunity to attend school. The one criterion, the presence or absence of brain pathology could be determined and the absence of such a defect was selected as the criterion for the classification of the mentally retarded group consisting of 18 children.

Classification of the institutionalized children in relation to determining the presence or absence of brain pathology was accomplished from several types of material. A social history, medical report, and electroencephalogram were available for each child and all of these were utilized in determining the appropriate classification. All of the institutionalized children used in the study had been placed in the institution on the basis of intelligence test scores and a failure to perform satisfactorily in an academic situation.

A pilot study was conducted in order to determine the most appropriate stimuli to be used in the visual discrimination problems and to determine the optimum chronological and mental age ranges within which the institutionalized children could successfully solve the problems. Ten institutionalized children of varying chronological ages, mental ages, and diagnostic categories were used. It was found that regardless of mental age, there was a tendency for older adolescent children to solve the problems faster than younger children. The very young institutionalized children (under 8 or 9) found the problems much too difficult. For this reason, institutionalized children between the age of 10 and 16 were selected. Another reason for not choosing younger children was that there were relatively fewer children below the age of 10 in the familial or mentally retarded classifications who were in the population of the institution.

The mental age range selected was ages 5 to, and including 7. In the pilot study, children with mental ages below 5 found the problems too difficult to solve and those children with mental age over 7 solved the problems too quickly.

The three groups finally selected consisted of 41 institutionalized children and 18 intellectually average children. Eighteen of the institutionalized children were mentally retarded and 23 were brain damaged or mentally defective. The mentally defective and mentally retarded groups were actually quite closely matched in relation to mental ability and chronological age of 13.7 years and a mean mental age of 6.2 years. The mentally retarded group had a mean chronological age of 13.5 years and a mean mental age of 6.6 years. Mental ages for these groups were all obtained from standardized intelligence tests. Either Stanford-Binet or the Wechsler Intelligence Scale for Children was administered to each child in the study. These tests had all been administered by qualified examiners and had all been administered within three years of the present study.

The group of normal children was selected from the residential areas of two different cities. Four of the children came from a university city with a population of 29,000. Fourteen of the children came from a large metropolitan city with a population of 700,000. All of the children were between the ages of 5 to, and including 7. Mental ages for these children were also between 5 to, and including 7 years as established by the administration of the Stanford-Binet Intelligence Test by the author of the present study. The mean mental age for the group of normal children was 6.1 years and the mean chronological age was 5.9 years.

The pilot study was also utilized to select the most appropriate stimuli to be used for the visual discrimination problems. Four different types of figures were evaluated:

1. Familiar figures such as dolls, toys, leaves, etc.
2. Non-familiar figures such as free forms, lines, etc.
3. Achromatic geometrical forms
4. Chromatic geometrical forms

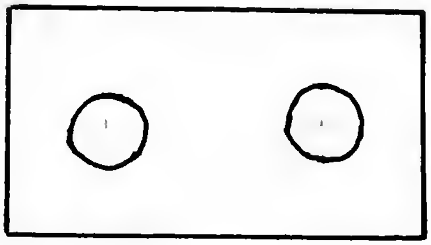
Familiar figures were found to be too easily distinguishable, making the solution of a problem too easy for children of almost any age. Non-familiar figures were too difficult to distinguish, making the problems much too hard. Geometric forms were easily distinguishable yet were sufficiently similar to prevent too quick a solution. Chromatic geometric figures were finally selected since they were more readily distinguishable than achromatic geometric forms.

The apparatus utilized consisted of the Harlow type visual discrimination problem set-up. There was a tray with two cups for candy. As a cover over these cups, two wooden blocks were placed. On the tops of the blocks were pasted colored geometric shapes. The candies utilized as reinforcing agents were candy coated chocolates small enough to fit into the cups, attractive in taste and appearance, and resistant to melting.

The procedure utilized was identical to that used by Riopelle (1953). Five visual discrimination problems were presented per session. Each problem was presented with one block as a positive one and always with a piece of candy below it. The blocks were moved from side to side in a predetermined random order. As each problem was solved, the next was presented until five were completed. The criteria for a successful solution were either five successive correct responses and/or a verbalization of the solution: i.e., "Oh, it's always under the same one." After five problems were complete, either the first or the fourth problem was re-presented with the positive and negative blocks reversed. By re-presenting the problem with the positive and negative blocks reversed, the effect of the originally learned response on the new material can be determined: i.e., proactive interference or negative transfer. By interpolating material between the originally learned responses and new responses (reversing the first or the fourth problems) a measure of retroactive interference is obtained.

Including the re-presented problem, each subject was presented six problems per day for a period of five days. From the fifty blocks constructed in order to have twenty-five separate problems, the blocks for each problem were selected at random. Within each daily series, the blocks were rotated for each child, the second set for the first child becoming the first set for the second child, etc., providing some control for the possible differences in difficulty between the sets of blocks.

A diagram of the apparatus used appears below:



CHAPTER 3

RESULTS

The first hypothesis stated that the mentally defective and mentally retarded groups with comparable intelligence test scores will perform differently in a non-test problem solving situation with the retarded children acquiring a learning set at a faster and more consistent rate than the defective children. It was also hypothesized that the mentally retarded children would acquire a learning set at about the same rate and consistency as the intellectually average children.

For statistical analysis, the twenty-five original problems were divided into five groups of five problems each. Such grouping seemed appropriate since the order of presentation of problems had been five problems per day for five successive days. In the original research design for the present study, the first hypothesis was to be tested by an analysis of the difference of the mean errors for the groups at each level of training. However, because of the excessively large variance in the performance of the brain damaged group (See Table 1) it was felt that the basic assumptions of normality of population distribution and homogeneity of variance could not be accepted.

Because normality and homogeneity of variance were questionable, a non-parametric statistic was selected. Such a statistic would compare two or more distributions without specifying the forms of the distributions. The median test was selected to test the hypothesis that the samples do not significantly differ from one another. For

Table 1

MEANS AND VARIANCES OBTAINED BY ALL THREE GROUPS ON THE ORIGINAL FIVE SETS OF PROBLEMS

	Brain Damaged		Non-Brain Damaged		Normal	
Problems	Mean Errors	Variance	Mean Errors	Variance	Mean Errors	Variance
1-5	30.4	102.71	5.12	5.86	4.9	5.23
6-10	25.26	82.22	1.98	3.81	1.5	1.91
11-15	21.20	82.65	.90	1.96	.69	1.55
16-20	21.62	82.62	1.00	1.97	.61	1.49
21-25	20.50	82.81	.80	1.68	.44	1.47

each group, data from the five problems presented were pooled and the median number of errors obtained (See Table 2). The number of cases in the samples falling above and below the median of the combined observations was determined. The resulting data were analyzed in a contingency table and the hypothesis was rejected if the observed chi square was larger than the critical value for one degree of freedom.

Using the median test, the first hypothesis was tested. The errors obtained by each group were compared to those errors obtained by each of the other groups. At all levels of training, the brain damaged group made significantly more errors than the non-brain damaged and normal groups (See Figure 1, page 23). Such differences were all significant at the .001 level of confidence. It can be seen from Figure 1 and Table 2 that the non-brain damaged children acquired a learning set at a faster and more consistent rate than the brain damaged group. The non-brain damaged or retarded group showed a decrease in errors from the first five problems to the second five problems. Performance then remained stable until the end of the series except for a small rise in errors on the fourth day of training.

The brain damaged group obtained more errors on the second day of training than were obtained on the first day. For this group, the number of errors then dropped on the third day, rose on the fourth day and finally decreased slightly on the fifth day.

There was no significant difference between the non-brain damaged and normal groups at any stages of training indicating that they acquired a learning set at about the same rate. It is interesting

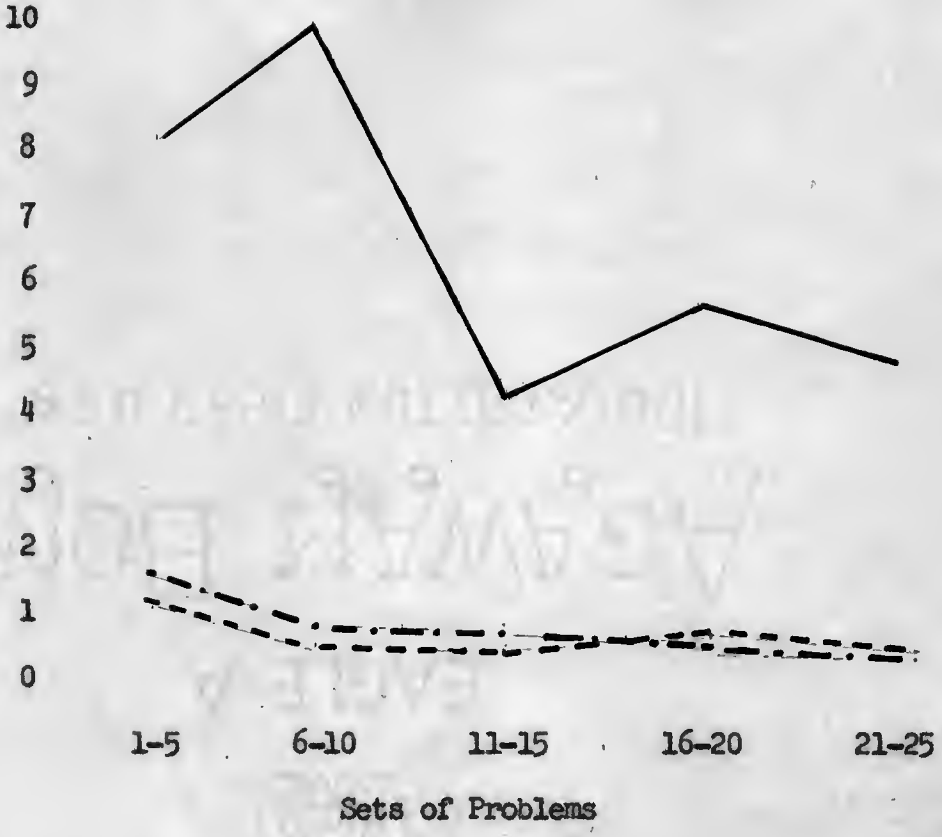


Figure 1. Median number of errors obtained by all three groups on original presentations of five sets of problems. Differences between the defective group and the other two groups is significant at the .001 level of confidence at all levels of training.

________ Brain Damaged

- - - - - Non-Brain Damaged

_ • _ • _ Normal

Table 2

MEDIAN NUMBER OF ERRORS FOR EACH GROUP ON ORIGINAL FIVE SETS OF PROBLEMS.

Problems	Brain Damaged	Non-Brain Damaged	Normal
1-5	8.3	1.2	1.5
6-10	9.6	.6	.8
11-15	4.3	.6	.8
16-20	5.5	.7	.5
21-25	4.7	.6	.5

Differences between defective and other two groups are significant at the .001 level at all stages.

to note, however, that until the third day of training, the intellectually normal children made slightly more errors than the mentally retarded group although there is no statistical difference between the number of errors.

The first hypothesis is supported. Mentally retarded children performed as well as intellectually average children in a non-test problem solving situation. Mentally defective children manifesting organic brain pathology performed significantly poorer than either the mentally retarded or the mentally average groups.

In order to measure the effects of proactive interference or negative transfer on the three groups, performance on the reversed problem was compared to performance on the original presentation of a problem for each subject. The median number of errors for the reversal and for the problem when it was first presented were determined for each of the groups. These data are presented in Table 3.

For all groups, at the early and middle stages of training, the number of errors obtained when the problem was originally presented. At least as far as total group performance is concerned, the interference predicted as a result of the cue reversal did not generally increase the number of errors. Apparently when the problems were re-presented, there was no persisting tendency to respond to the stimulus which had been positive at the first presentation. It would seem that either the subjects approached each problem as a new situation, forgetting their previous responses, or else, the re-presenting of the problems was actually facilitating rather than interfering. Once the subjects became aware that their first responses were now incorrect, they could very quickly change to the correct response.

The significance of the differences in performance between original presentations and re-presentations of problems was determined. Since each subject was observed under two conditions, the original presentation and the reversal of a problem any test would be invalid. Hence, the non-parametric statistic, the sign test, was utilized. The number of positive and negative differences between the errors obtained under the two conditions was obtained and the null hypothesis was rejected when the number of positive and negative signs differed significantly from equality. The differences between errors on the original and reversed presentations are presented in Table 4.

For the defective group, the number of people obtaining more errors than fewer errors on the reversals is significantly greater at the .01 level of confidence. For this group, proactive interference was marked at the last stages of training, but was not operative at the initial stages. For the non-brain damaged and average groups, significant proactive interference was absent at all stages of training. In fact, the decrease in the number of errors when problems were reversed at the end of the first five problems is significant for the average group at the .01 level of confidence.

Hence the hypothesis that proactive interference would be greater for the brain damaged group is only partially supported for it is only at the last level of training that such interference is significant.

Table 3

MEDIAN NUMBER OF ERRORS OBTAINED ON THE ORIGINAL PRESENTATION AND REVERSAL OF PROBLEMS AT EACH STAGE OF TRAINING FOR ALL THREE GROUPS.

	Brain Damaged (Defective)		Non-Brain Damaged (Retarded)		Average	
Problems	Original	Reversal	Original	Reversal	Original	Reversal
1-5	13	8	10	2	5	1
6-10	10.5	5	1	2	1	1
11-15	9	5	1.5	1	1	1
16-20	3	5	1	1	1	1
21-25	2	4	1	1	1	1

The third hypothesis stated that there would be a greater suppression of performance efficiency with one interpolated problem (fourth problem reversed) than with four interpolated problems (first problem reversed) for the brain damaged group. It was stated that the brain damaged group, because of poor immediate memory, poor attention span, distractibility, etc., would manifest less interference after four interpolated problems because they would be more likely to forget the block which had been originally reinforced. It was further felt that there would be more interference in performance after one interpolated problem due to the fact that these subjects would be less likely to shift from responding to one block as positive to responding to the previously negative block as now positive. Such a shift after only one interpolated problem should be difficult because of the trait of rigidity characteristic of the brain damaged individual. Table 5 presents the median errors obtained by each group at each level of training for both the original and reversed problems when the fourth problems are reversed.

Table 6 presents the median errors obtained by each group for both the original and reversed problems when the first problems are reversed.

The data presented in Tables five and six are portrayed graphically in Figures 2, 2a, 3, 3a, 4, and 4a.

The sign test was again utilized to determine the significance of differences between performance on original and reversed presentations of the problems. Table 7 presents the positive and

Table 4

THE NUMBER OF POSITIVE AND NEGATIVE DIFFERENCES BETWEEN ERRORS OBTAINED ON ORIGINAL PRESENTATION AND REVERSAL OF PROBLEMS FOR ALL THREE GROUPS AT EACH STAGE OF TRAINING.

	Brain Damaged (Defective)		Non-Brain Damaged (Retardwd)		Average	
Problems	+	-	+	-	+	-
1-5	8	7	13	5	14	2
6-10	8	11	5	10	6	10
11-15	7	11	3	8	3	2
16-20	4	12	4	7	3	10
21-25	1	11*	2	2	6	5

*= significant differences at the .01 level of confidence.

Table 5

MEDIAN ERRORS OBTAINED BY EACH GROUP AT EACH LEVEL OF TRAINING FOR ORIGINAL PRESENTATIONS AND ON REVERSED PRESENTATIONS WHEN ONLY THE FOURTH PROBLEMS ARE REVERSED.

	Brain Damaged (Defectives)		Non-Brain Damaged (Retarded)		Average	
Problems	Original	Reversed	Original	Reversed	Original	Reversed
1-5	15	6	9	3	4	1
6-10	4.5	4.5	1	1	1	1
11-15	7.5	8.5	1	1	1	1
16-20	2	2.5	1	1	1	1
21-25	1	7	1	1	1	1

Table 6

THE MEDIAN ERRORS OBTAINED BY EACH OF THE THREE GROUPS AT EACH LEVEL OF TRAINING FOR BOTH THE ORIGINAL AND REVERSED PRESENTATIONS OF PROBLEMS WHEN ONLY THE FIRST PROBLEMS ARE REVERSED.

	Brain Damaged		Non-Brain Damaged		Average	
Problems	Original	Reversed	Original	Reversed	Original	Reversed
1-5	12	12.5	17	1	8	1
6-10	5	11	2	2	1	1
11-15	7.5	3.5	1	1.5	1	1
16-20	14	9	1	1	1	1
21-25	2	3	1	1	1	1

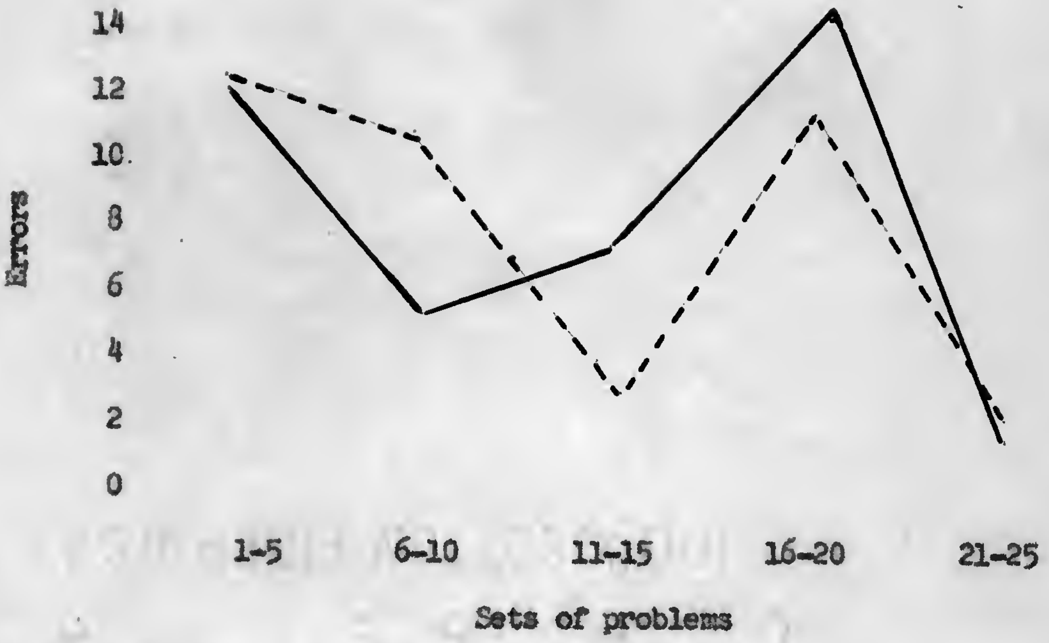


Figure 2. Median errors on original and reversed presentations of first problems for the brain damaged group.

__________ Original learning

- - - - - Reversals

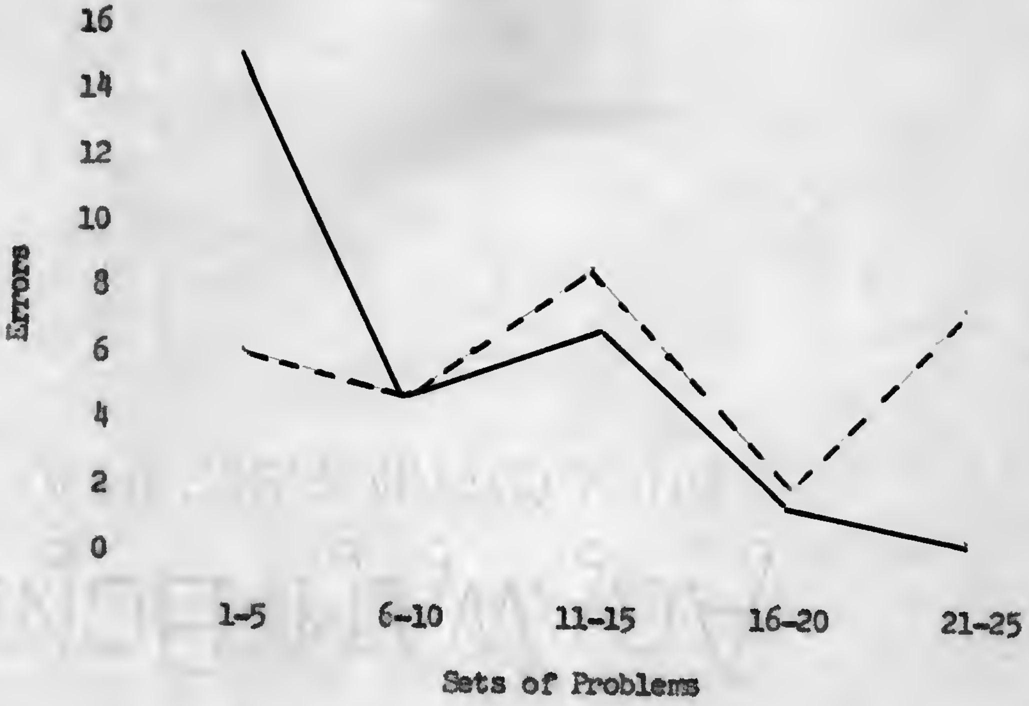


Figure 2a. Median errors on original and reversed presentations of fourth problems for the brain damaged group.

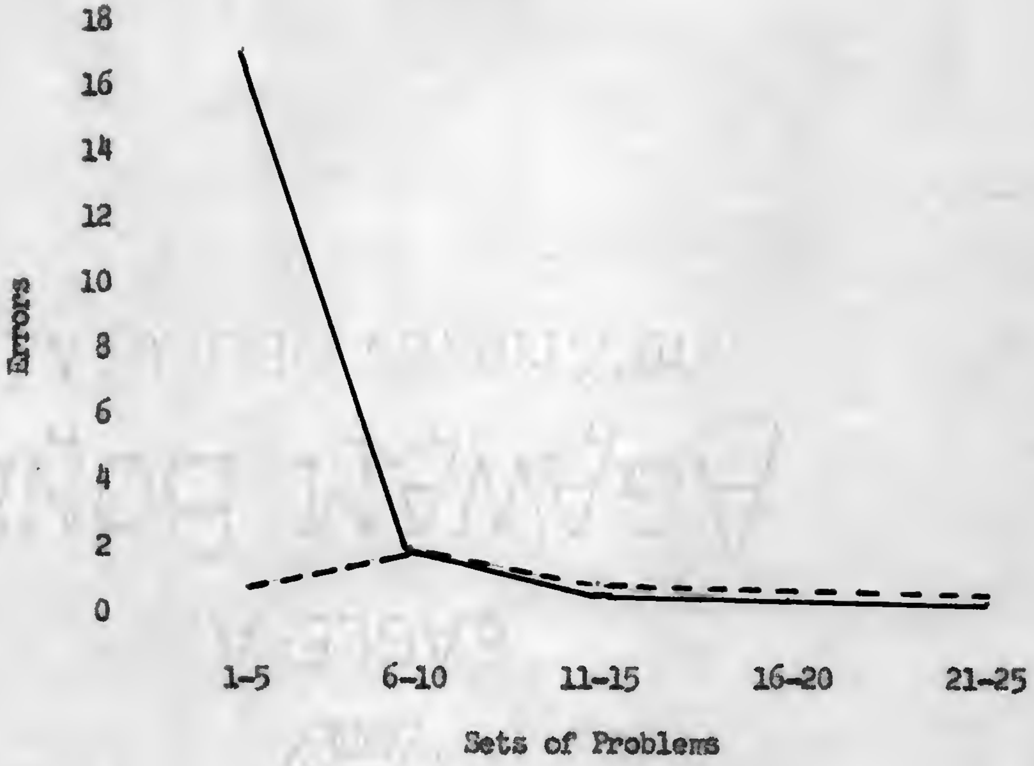


Figure 3. Median errors on original and reversed presentations of first problems for the non-brain damaged group.

________ Original learning

- - - - - Reversals

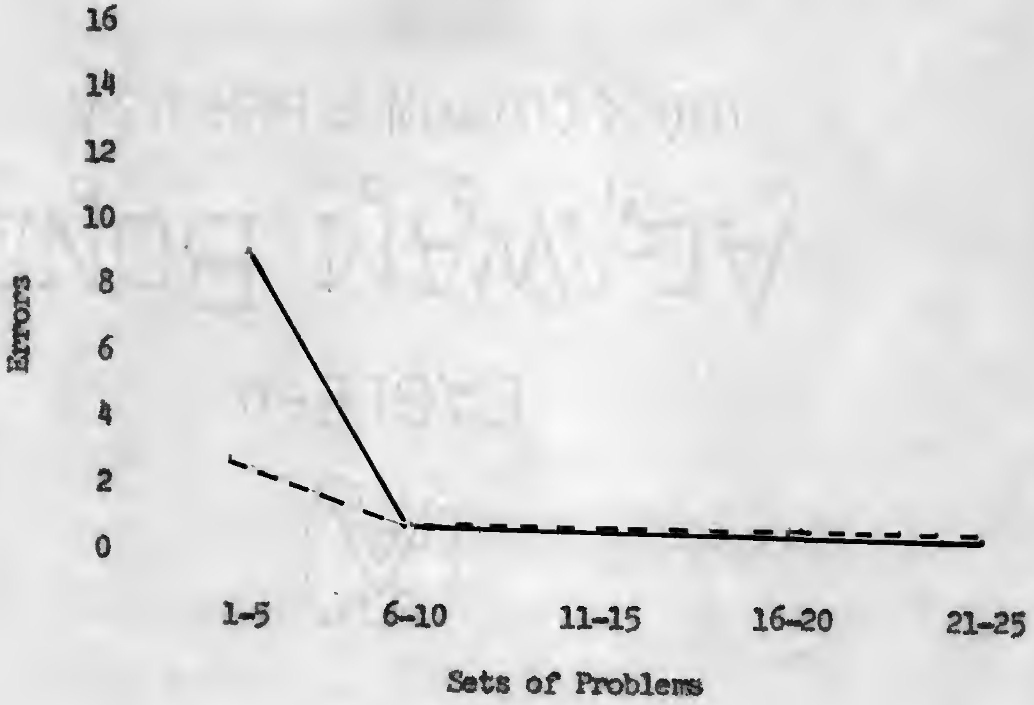


Figure 3a. Median errors on original and reversed presentations of fourth problems for the non-brain damaged group.

———— Original learning

- - - - - Reversals

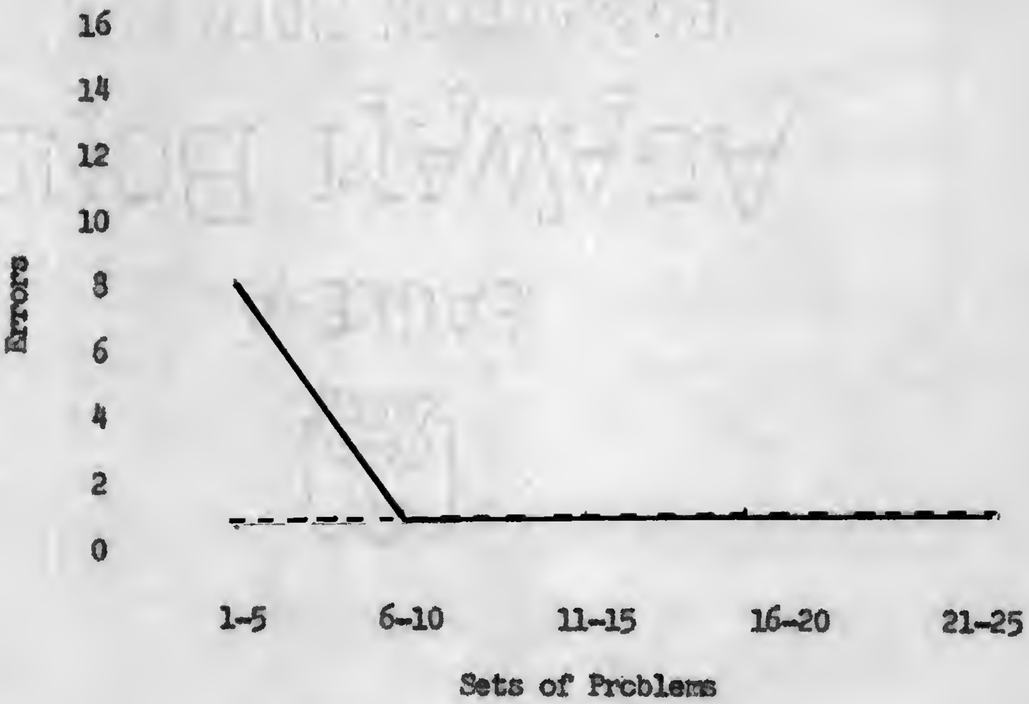


Figure 4. Median errors on original and reversed presentations of first problems for the average group.

________ Original learning

- - - - - Reversals

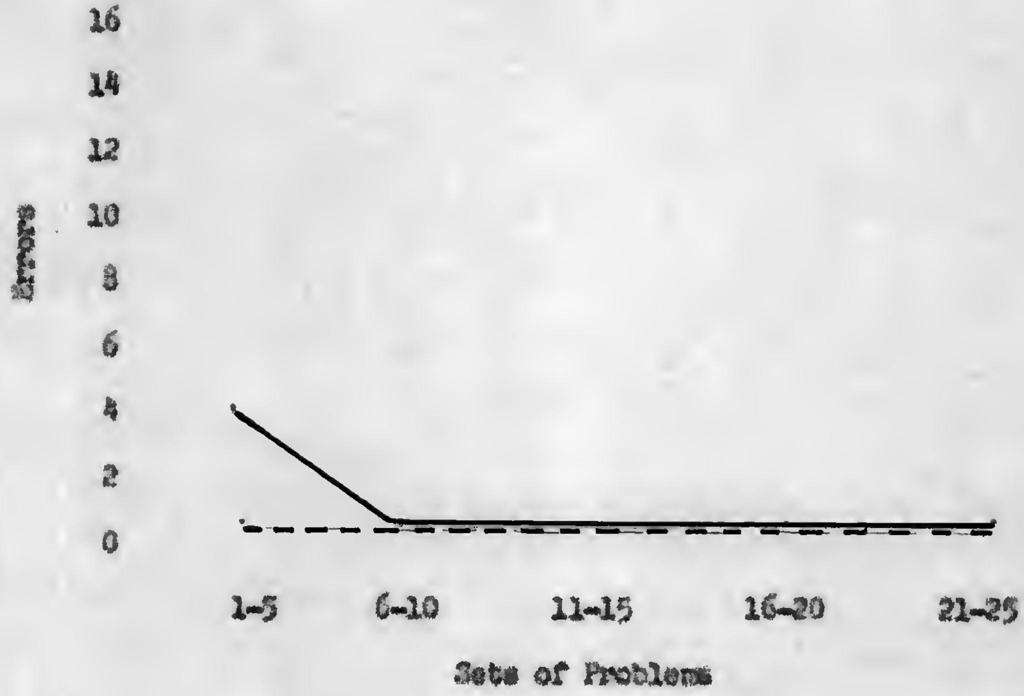


Figure 4a. Median errors on original and reversed presentations of fourth problems for the average group.

________ Original learning

- - - - - Reversals

Table 7

POSITIVE AND NEGATIVE DIFFERENCES BETWEEN ERRORS ON THE ORIGINAL AND REVERSED PRESENTATIONS OF FIRST AND FOURTH PROBLEMS FOR ALL THREE GROUPS.

Group	Reversal of First Problem		Reversal of Fourth Problem	
	+	-	+	-
Brain Damaged	15	23	12	29*
Non-Brain Damaged	16	15	10	21
Average	11	4	9	8

* = Significant at the .01 level of confidence.

negative differences between errors on the original and reversed presentations and their significances for all three groups. Since the data had been divided into two groups, presentations and reversals of first problems and fourth problems, there were not enough subjects in each of the groups at each stage of training to provide a valid estimation of significance of differences. Hence the data for all five stages of training were combined within each grouping of first or fourth reversals.

For all three groups, the differences in performance between the original and reversed presentation are not significant when the first problems are reversed. When the fourth problems are reversed, the brain damaged group show a difference significant at the .01 level of confidence, indicating that this group made significantly more errors on reversed problems when the fourth problems were reversed.

Thus, the second hypothesis that proactive interference would be greater for the brain damaged group is only partially supported, for it is only at the last level of training that such interference is significant.

The third hypothesis stated that for the brain damaged group there would be a greater suppression of performance efficiency with one interpolated problem than with four interpolated problems. Results indicate that this hypothesis is supported since this group made significantly more errors on reversed problems when the fourth problems are reversed.

CHAPTER 4

DISCUSSION

The purposes of the present study have been: first, the comparison of the performances of mentally subnormal and mentally normal children in a series of non-test problem solving situations, and second, a comparison of learning processes between two different clinical groups of mentally subnormal children.

The first hypothesis stated that: (a) mentally retarded children will perform similarly to intellectually average children in a non-test problem solving situation, one which will provide the children with an opportunity to evaluate the appropriateness of their solutions as well as requiring them to solve problems. In addition (b) mentally defective and mentally retarded children with similar intellectual ability as measured by standardized intelligence tests will perform differently in a non-test problem solving situation, with the defective children acquiring a learning set at a much slower rate than retarded children.

The first hypothesis was completely supported. Mentally subnormal children can perform as well as mentally normal children in a series of non-test visual discrimination problem solving situations. There was no significant difference between the errors obtained by the retarded and average groups. The learning set acquisition curves for these two groups indicate a consistent and rapid rate of learning. Errors decreased steadily from the first day of training to the second day and remained consistently low throughout the remainder of the series of problems. Actually, at the first two stages of training, the retarded children obtained fewer errors than the average children, although this difference was not statistically significant. Such a difference in performance in this direction was probably due to the fact that the retarded children had slightly higher mental ages than the average children and the fact that the retarded were considerably older than the average children chronologically. It was felt that their greater maturity and experience were the primary factors involved. The preliminary pilot study indicated that older children learned more quickly than younger children even when both groups were retarded. It was frequently noted during the preliminary and present study that the older retarded and defective children were extremely alert to many extraneous and less obvious clues in the environment and were able to utilize such cues as clues to the correct location of the candy, i.e., the shadow cast by the examiner's arm on the wall, the angle of the examiner's bent elbow, and the direction from which came the sound of the candy being placed in the cup. Sarason and Gladwin (1958) raised the question of the development of evaluative thinking with increasing chronological age. One might hypothesize that the ability to utilize what Guilford (1956) refers to as evaluative thinking may be present in younger children but as a child grows older, he is able to utilize more distant but relevant cues in solving problems and evaluating solutions. Hence, the efficiency and appropriateness with which he evaluates his behavior may develop with age. The chronologically younger children of average and subnormal intelligence did evaluate their responses, but could do so only within narrow limits, i.e., they focused on the block, the cup, and the candy, and were unaware of the more distant cues.

The acquisition curve for the defective group indicates that a learning set is acquired at a much slower and more inconsistent rate. The extreme variability of performance within this group is notably striking. In other words, some of the brain damaged children solved the problems very quickly while others found it extremely difficult. Actually five of the defective subjects were unable to solve any of the problems even after repeated trials. Probably the heterogeneity of this group is a primary factor in such variability. While the children in the defective group were selected on the basis of brain injury alone without concomitant hormonal or metabolic disorders, certainly the locus of brain injury would vary from subject to subject. Some of the children may have had difficulty in perceiving visual stimuli. Others may have been unable to form and utilize higher order abstractions such as, in this study, "it's always under the same block." Still others may have had difficulty in even perceiving that there was any patterning involved in placing the candy in the various cups. The poor performances manifested by so many of the defective children did not seem to stem from an inability to evaluate the appropriateness of their responses. All except five of these children did attempt to evaluate what they were doing. They formed many hypotheses throughout the training sessions and, for the most part, were able to change hypotheses when they felt that their responses were not confirming them. Primarily the poor performance of the defective children seemed to be due to intellectual and personality factors considered to be typical of such children; i.e., rigidity, perseveration, poor attention span, poor memory, and concretism. These characteristics seemed to prevent the defective children from really paying attention to the relevant aspects of the problems. Although they formed hypotheses relating to position or pattern of placement of the blocks, a few of the children were unable to shift to the correct block even when the incorrect (but preferred) block was consistently not reinforced. These children continued to respond incorrectly trial after trial. Five children never solved any of the problems. Actually after two of these subjects had completed the entire series of problems without solving any, the examiner, out of curiosity, continued to present the stimuli with no reinforcement of either block. The subjects continued to select the same preferred block until the examiner tired. Even when the blocks were not alternated from side to side, the subjects continued to select the preferred block. There was nothing outstanding in the histories, EEG's, or test scores of these children to have indicated or predicted their failure to learn. For example, the estimates of brain damage (mild, deep, etc.) made by the physician who evaluated the EEG's varied from child to child. In two cases such damage was considered milder and more superficial in comparison with some of the brain damaged children who learned quickly. Test scores for these children were also comparable to those of the other brain damaged and the non-brain damaged retarded children.

A number of the children, both brain damaged and retarded, did not verbalize an hypothesis, but formed left or right preferences. For the most part, they were able to shift to another response after continued reinforcement of the appropriate block.

Concretism was displayed by the children who were able to develop the concept of one block being consistently reinforced for each individual problem but were unable to carry this concept over to the next different but similar problem. These children approached each problem as a new and unfamiliar one.

However, it must be emphasized that some of the brain damaged children (seven subjects) did solve the problems very quickly, similarly to the non-brain damaged and normal groups, were able to acquire a learning set early in the series, and could carry the set over to the succeeding problems.

Hypothesis number two predicting greater proactive interference for the defective group than for either the retarded and average groups was only partially supported. The results of the sign test indicated that at all levels of training, for the retarded and average groups, there was no significant difference between the number of people obtaining more errors and those obtaining fewer errors on reversals of problems. A comparison of the median number of errors obtained by these groups under both conditions (original and reversed presentations) readily indicates that after the first five problems, both original and reversed presentations of problems were quickly solved in about the same number of trials.

For the defective group, it is only at the final stage of training that more subjects made more errors than fewer errors on reversals. For this group, proactive interference increased rather than decreased as learning progressed. This result seems paradoxical since there is considerable evidence indicating that, in general, as learning progresses and the more clearly previous activities can be discriminated, the less they should be confused with current activity (Osgood, 1953). The reason for an increase in interference rather than a decrease as learning progressed for the defective group becomes clearer when a comparison between performance on reversals after one interpolated problem and performance after four interpolated problems is made. This comparison will be emphasized in the discussion of hypothesis three.

Hypothesis three stated that for the defective group, in contrast to the other groups, interference should be greater after one interpolated problem than after four interpolated problems because the defective group would be less able to shift from responding to one block as positive in the original presentation to responding positively to the previously negative block at the reversed presentation. This prediction was supported. When fourth problems were reversed (one interpolated problem), the number of subjects in the brain damaged group making more errors than on the original presentation was significantly greater (.01 level of confidence) than the number of subjects making fewer errors. While the sign test could not be utilized at each separate stage of training, a comparison of the median number of errors obtained on original and reversed presentations indicates that with four interpolated problems, when a subject did not have to shift suddenly to responding positively to an immediately preceding negative stimuli, at the final stages of training, fewer or about the same number of errors were obtained on reversals as were obtained on the original presentations of problems. Apparently, as original learning progressed and the problems became more clearly discriminated, facilitation occurred, as might be expected according to Osgood (1953). When there was only one interpolated problem before a shift in both stimulus and response is required, confusion ensued primarily because of such difficulty in shifting response sets suddenly for the brain damaged group. Hence, the paradoxical finding for this group, when both one and four interpolated problems are considered, that as original learning progressed to the last stage of training, interference became maximum and significant. As problems became more clearly discriminated, it is then more difficult for the brain damaged child to shift to a new and directly reversed response than when the problems are less clearly discriminated.

In summary, the above results of the current study indicate that, as predicted, intellectually subnormal children and intellectually average children with equivalent mental ages can learn equally well in non-test problem solving situations such as the series of visual-discrimination learning problems. However, it is the intellectually retarded (non-brain damaged) who perform as efficiently in such situations as the intellectually average. Mentally defective (brain damaged) children functioned significantly poorer than either the average or retarded children in solving such problems. Although, as a group, the defective children learned slowly and at an inconsistent rate, the variability within the group was striking. Some children learned to solve the problems quickly. Others solved them very slowly or not at all.

When the effects of proactive and retroactive interference on performance were considered, interference was greater for the defective group than for either the retarded or the average groups. The retarded and average groups showed no significant effects of interference. As in original learning of the problems, the retarded children performed similarly to the average children. Again the defective children displayed marked variability in effects of proactive and retroactive interference. The main implication suggested by the above statements is that: one cannot predict that all brain damaged children will not learn quickly and efficiently. This will vary from child to child.

The evidence from the present study casts considerable doubt upon the validity of standardized intelligence tests as a sole means of arriving at many conclusions concerning mental retardation. Even more glaringly suggested is the possibility that standardized intelligence tests measure only a narrow range of problem solving situations. Certainly, in the present study, children with similar intellectual ability as measured by such tests performed differently in a series of specific non-test problem solving situations.

In addition, the data obtained in the present study raise questions relating to the training of children of sub-normal intelligence. If defective and retarded groups with comparable intellectual ability as measured by intelligence tests, manifest a vast difference in ability to solve problems, it would seem necessary to provide vastly different training and educational programs for these children in training schools and special classes.

As a result of the current study, several possibilities for future study become apparent:

1. No brain damaged children of average intellectual ability were included in the study because the purposes of this study were to compare children of sub-normal intelligence with those of normal intelligence and to compare children of sub-normal intellectual ability with different clinical classification. Those characteristics typical of brain damaged children such as defects in memory, attention span, etc., probably also affect the performances of brain damaged children of average intelligence. An evaluation of the effects of such characteristics on the performances of these children in a non-test problem solving situation might prove valuable.

2. Further study of the wide variability between brain damaged children seems warranted. While the loci of damage and the extent of damage are important factors, it is often difficult to determine these accurately. Perhaps the development of tests such as the new Illinois Test of Psycholinguistic Abilities which is not yet widely available (Kirk, 1961) may prove invaluable. Such a test purports to determine the specific psychic and linguistic function affected by the brain damage. Perhaps there is a relationship between the type of function disturbed or the number of functions disturbed and the ability to efficiently solve problems.

3. Since it seems evident that learning for many brain damaged children is impaired by certain disturbances of personality and intellect, one wonders whether appropriate training methods can be developed to overcome or to minimize the effects of such disturbances thus enabling these children to learn more efficiently?

CHAPTER 5

SUMMARY AND CONCLUSIONS

The present study represents a convergence of two lines of interest:one, a comparison of the performances of intellectually subnormal and intellectually average children in a non-test problem solving situation, and two: a comparison of learning processes between different clinical groups of mentally subnormal children.

Much of the available literature seems to indicate that the ability to solve problems may be better in a non-test situation than in a test situation. There has also been evidence that the adult level of non-test problem solving performances of many individuals who, as children, received test scores indicating retardation, is better than might have been predicted from their test scores. Studies by Baller (1936), Muench (1944), and Ginzberg and Bray (1953) indicate two main points. One is that retarded individuals may perform differently (and often better) in a non-test problem solving situation than they do in a test situation. The second point is the clear inadequacy of many conclusions related to mental retardation which have been based on data obtained solely from intelligence test scores.

The problem of diagnosing and classifying mental subnormality is complex and can be made only in relation to some external criterion of mental normality. Distinctions must be made within the classification of mental subnormality. Sarason and Gladwin (1958) distinguish between "mental deficiency" and "mental retardation". The term "retardation" presumes no organic pathology can be detected. The term "deficiency" presumes the presence of detectable organic pathology. There are a number of disturbances of intellect and personality which are considered to be characteristic of the brain damaged child and reflected in behavior. Such characteristics are: disturbances of attention and memory, perseveration, rigidity, and concretism.

The purposes of this study are to test the following assumptions: one, children judged to be retarded on the basis of intelligence test scores may perform more adequately in a non-test problem solving situation. Two, retarded children will perform more like normal children in a non-test problem solving situation, but brain damaged children will perform inadequately in such a situation. The non-test problem solving situation consisted of a series of twenty-five visual discrimination problems. For each problem one stimulus was always positive and one was always negative. Five problems were presented each day for five consecutive days. At the end of each day's session either the first or fourth problem was re-presented but with the positive and negative stimuli reversed in order to obtain measures of proactive and retroactive interference.

The following hypotheses were tested:

1. Mentally retarded children will perform similarly to intellectually average children in a non-test problem solving situation which gives the children an opportunity to evaluate the appropriateness of their responses to given stimuli.

1a. Mentally defective (brain damaged) and mentally retarded (non-brain damaged) children with the same intellectual ability as measured by standardized intelligence test will perform differently in a non-test problem solving situation. It is predicted that the brain damaged children, because of the characteristic disturbances of memory, attention span, distractibility, perseveration, etc. typical of such children, will acquire a learning set at a much slower rate than retarded or non-brain damaged children.

2. The suppressive effects of previously learned responses on new material is referred to as proactive interference. It is predicted that the effects of such proactive interference will be greater for the mentally defective children than for the mentally retarded and average children because of the difficulty for the defective children in shifting set from originally learned responses to new material.

2a. It is predicted that there will be no significant difference between the retarded and average groups in relation to the effects of proactive interference.

3. With the introduction of interpolated material, a suppression of previously learned material is referred to as retroactive interference. It is predicted that there will be a greater suppression of performance efficiency for the defective group than for the other two groups with one interpolated problem because of a difficulty in shifting from one set to another for this group. It is predicted that the defective children will manifest less interference in performance after four interpolated problems because they would be more likely to have forgotten which lbocks had originally been reinforced.

3a. It is predicted that there will be no significant difference between the retarded and average groups in relation to the effects of retroactive interference.

Fifty-nine subjects were utilized in the study. Forty-one of the subjects were children institutionalized in a school for mental defectives. Eighteen of the institutionalized children were mentally retarded (non-brain damaged) and twenty-three were mentally defective (brain damaged). Eighteen of the subjects were non-institutionalized and intellectually average.

Analysis of the data provides the following conclusions:

1. The first hypothesis that mentally subnormal children perform as well as mentally normal children in a non-test problem solving situation is completely supported. There was no significant difference between the errors obtained by the retarded and average groups.

   It was also hypothesized that the mentally defective and mentally retarded groups with comparable intelligence test scores will perform differently in a non-test problem solving situation with the retarded children acquiring a learning set at a faster and more consistent rate than the defective children. This hypothesis is completely supported. The difference between performances of the two groups is significant at the .001 level of confidence.

2. Hypothesis number two predicting greater proactive interference for the defective group than for either the retarded and average groups was only partially supported since, for the defective group, it is only at the final stage of training

that more subjects made more errors than fewer errors on reversals. There was no sex difference between the average and retarded groups.

3. Hypothesis three stated that for the defective groups, in contrast to the other groups, interference should be greater after one interpolated problem than after four interpolated problems. This hypothesis was supported. The number of subjects in the brain damaged group making more errors than on the original presentation was significantly greater than those subjects making fewer errors (.01 level of confidence). There was no significant difference between performances of the average and retarded groups.

It is felt that evidence from the present study casts considerable doubt upon the validity of standardized intelligence tests as a sole means of arriving at many conclusions concerning mental retardation. Also suggested is the possibility that standardized intelligence tests measure only a narrow range of problem solving situations.

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APPENDIX I. DESCRIPTION OF THE EXPERIMENTAL AND CONTROL GROUPS.

	Groups		
	Defective (Brain Damaged)	Retarded (Non-Brain Damaged)	Average
Number of Subjects	23	18	18
IQ Ranges	48-61	44-64	98-109
Chronological Age (Ranges in months)	131-192	123-192	60-83
X C.A. (Months)	165	162	69
Mental Age (Ranges in months)	63-94	60-92	60-90
X C.A. (Months)	74	78	73

BIOGRAPHICAL SKETCH

Marylyn N. Voerg was born June 29, 1927, at Chicago, Illinois. In 1935, she moved to St. Petersburg, Florida, where she attended public schools and St. Petersburg Junior College. She completed her Bachelor of Arts degree at the University of Florida in 1950 and her Master of Arts degree in 1957 at the same University. In 1960 she completed a year's internship in Clinical Psychology at Washington University Medical School in St. Louis, Missouri. Since that time, she has been employed as a Staff Psychologist at the Child Psychiatric Clinics of Washington University in St. Louis.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council, and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

April 18, 1964

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